

1    **What is claimed is:**

2            1.    A method of demagnetizing magnetic media for recording data in a  
3    data storage device, comprising the steps of:  
4                (a)    placing the magnetic media in a magnetic field at a first strength  
5    level; and  
6                (b)    gradually reducing the magnetic field to a second strength level to  
7    essentially eliminate net magnetization in the magnetic media.

8  
9            2.    The method of claim 1, wherein step (b) further includes the steps  
10   of reducing the magnetic field by multiple stepwise decrements in the magnetic  
11   field to reach the second level.

12  
13            3.    The method of claim 2, wherein said stepwise decrements are  
14   separated by predetermined time periods.

15  
16            4.    The method of claim 2, wherein the magnitude of each decrement  
17   is based on the magnetic coercivity of the magnetic media.

18  
19            5.    The method of claim 2, wherein said first strength level is based on  
20   the magnetic coercivity of the magnetic media.

21  
22            6.    The method of claim 2, wherein said second strength level is  
23   substantially zero.

24  
25            7.    The method of claim 1, wherein said magnetic field is substantially  
26   perpendicular to the surface of the magnetic media.

27  
28            8.    The method of claim 1, wherein:  
29                step (a) further includes the steps of:  
30                      positioning an electromagnet proximate the magnetic media; and

1                   providing electrical power to the electromagnet to generate said  
2 magnetic field at said first level; and

3                   step (b) further includes the steps of gradually reducing the electrical  
4 power to the electromagnet to reduce the magnetic field to said second level.

5

6                 9. A method of demagnetizing a magnetic data disk for recording data  
7 in a disk drive, comprising the steps of:

8                 (a) placing the magnetic data disk in a magnetic field at a first strength  
9 level; and

10                 (b) gradually reducing the magnetic field to a second strength level to  
11 essentially eliminate net magnetization in the magnetic media.

12

13                 10. The method of claim 9, wherein:

14                   the data disk includes opposing surfaces having magnetic medium  
15 thereon;

16                   step (a) further includes the steps of:

17                   placing an electromagnet proximate each surface of the data disk,  
18 such that at least a portion of each surface of the data disk is between the  
19 electromagnets;

20                   providing electrical power to the electromagnets to generate said  
21 magnetic field at said first level; and

22                   rotating the data disk in relation to the electromagnets such that the  
23 magnetic field is substantially perpendicular to said surfaces of the data disk.

24

25                 11. The method of claim 9, wherein:

26                   step (b) further includes the steps of reducing the magnetic field by  
27 multiple stepwise decrements in the magnetic field to reach the second level.

28

29                 12. The method of claim 11, wherein said stepwise decrements are  
30 separated by predetermined time periods.

31

1        13. The method of claim 12, wherein the duration of each time period is  
2 based on the speed of rotation of the data disk.

3

4        14. The method of claim 12, wherein the duration of each time period is  
5 at least longer than duration of a revolution of the data disk.

6

7        15. The method of claim 11, wherein the magnitude of each decrement  
8 is based on the magnetic coercivity of the magnetic media.

9

10        16. The method of claim 10, wherein said magnetic field is substantially  
11 perpendicular to the surface of the magnetic media.

12

13        17. The method of claim 10, wherein step (a) further includes the steps  
14 of moving the electromagnets essentially radially in relation to the rotating data  
15 disk to expose recording area on the disk surfaces to said magnetic field.

16

17        18. An apparatus for demagnetizing magnetic media for recording data  
18 in a data storage device, comprising:

19              an electromagnet which generates a magnetic field when provided  
20 with electrical power;

21              a first support for positioning the magnetic media proximate the  
22 electromagnet such the magnetic field overlaps at least a portion of the magnetic  
23 media; and

24              a controller for selectively providing electrical power to the  
25 electromagnet to generate magnetic fields at different strength levels, wherein  
26 the controller is configured to gradually reduce electrical power to the  
27 electromagnet from a first power level to a second power level, to reduce the  
28 magnetic field from a first strength level to a second strength level, respectively,  
29 to essentially eliminate net magnetization in the magnetic media.

30

31        19. The apparatus of claim 18, wherein:

1 the magnetic media comprises a magnetic data disk having opposing surfaces  
2 for recording data thereon;

3                   the electromagnet is positioned proximate a surface of the data  
4 disk;

5                   the apparatus further comprises a motor for rotating the data disk in  
6 relation to the electromagnet such that the magnetic field is substantially  
7 perpendicular to said surfaces of the data disk.

8

9                 20. The apparatus of claim 18, wherein the controller is further  
10 configured to reduce the magnetic field by multiple stepwise decrements in the  
11 magnetic field to reach the second strength level.

12

13                 21. The apparatus of claim 20, wherein said stepwise decrements are  
14 separated by predetermined time periods.

15

16                 22. The apparatus of claim 21, wherein the duration of each time period  
17 is at least longer than duration of a revolution of the data disk.

18

19                 23. The apparatus of claim 20, wherein the magnitude of each  
20 decrement is based on the magnetic coercivity of the magnetic media.

21

22                 24. The apparatus of claim 18, wherein said magnetic field is  
23 substantially perpendicular to the surface of the magnetic media.

24

25                 25. The apparatus of claim 19 further comprising:

26                   a second support for moving the electromagnet essentially radially  
27 in relation to the rotating data disk to expose recording area on the disk surfaces  
28 to said magnetic field.

29

30                 26. A method of demagnetizing magnetic media for recording data in a  
31 data storage device, comprising the steps of:

1                   (a) determining a recording frequency for writing on the magnetic  
2 media with a transducer head, at which the amplitude of the transducer head  
3 readback signal from said portion of the magnetic media is essentially at noise  
4 level; and  
5                   (b) writing on the magnetic media at substantially said recording  
6 frequency, to substantially eliminate net magnetization in the magnetic media.

7

8                 27. The method of claim 26, wherein:

9                   step (a) further includes the steps of:

10                  (i) writing on a portion of the magnetic media with the  
11 transducer head at a selected recording frequency;  
12                  (ii) reading from said portion of the magnetic media, generating  
13 a readback signal;  
14                  (iii) if the amplitude of the readback signal is not essentially at  
15 noise level, then repeating steps (i) through (iii) for a different selected recording  
16 frequency, until the amplitude of the readback signal is essentially at noise level;  
17 and

18                  step (b) further includes the steps of writing on the magnetic media at the  
19 last selected recording frequency, to substantially eliminate net magnetization in  
20 the magnetic media.

21

22                 28. The method of claim 26, wherein:

23                   step (a) further includes the steps of:

24                  writing on the magnetic media with a transducer head at one or  
25 more different recording frequencies, and comparing the amplitude of a readback  
26 signal at each recording frequency to noise level;

27                  selecting a recording frequency at which the amplitude of the  
28 readback signal is essentially the same as the noise level; and

29                  step (b) further includes the steps of writing on the magnetic media at  
30 substantially said selected recording frequency, to essentially eliminate net  
31 magnetization in the magnetic media.

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2 29. The method of claim 26, wherein:

3 step (a) further includes the steps of:

4 (i) selecting a recording frequency;

5 (ii) writing on a portion of the magnetic media with a transducer

6 head at the selected recording frequency;

7 (iii) reading from said portion of the magnetic media with said

8 transducer head, generating a readback signal;

9 (iv) if the amplitude of the readback signal is greater than a

10 noise level, then selecting another recording frequency, and repeating steps (ii)

11 through (iv) until the amplitude of the readback signal is essentially at said noise

12 level; and

13 step (b) further includes the steps of writing on the magnetic media at the

14 last selected recording frequency.

15

16 30. The method of claim 29, wherein in step (a)(i) selecting a recording  
17 frequency includes selecting a nominally low frequency.

18

19 31. The method of claim 30, wherein the step of selecting another  
20 recording frequency comprises selecting a recording frequency higher than a  
21 preceding recording frequency.

22

23 32. The method of claim 29, wherein the step of selecting another  
24 recording frequency comprises selecting a recording frequency lower than a  
25 preceding recording frequency.

26

27 33. The method of claim 27, wherein:

28 the storage media comprises a magnetic data disk for writing data thereon  
29 in concentric tracks;

30 in step (a)(i) writing on the magnetic media comprises writing on a test  
31 track on the magnetic disk;

1       in step (a)(ii) reading from the magnetic media comprises reading from  
2       said test track on the magnetic disk; and  
3            in step (b) writing on the magnetic media includes writing on multiple  
4       tracks on the magnetic disk at said last selected recording frequency, to  
5       substantially eliminate net magnetization in said multiple tracks.

6

7       34.    A data storage device, comprising:  
8           magnetic media for recording data thereon,  
9           a transducer head for recording data on the magnetic head at  
10      different recording frequencies;  
11           a controller configured for demagnetizing the magnetic media for  
12      recording data, wherein the controller: determines a recording frequency for  
13      writing on the magnetic media with a transducer head, at which the amplitude of  
14      the transducer head readback signal from said portion of the magnetic media is  
15      essentially at a noise level; and controls the transducer head to write on the  
16      magnetic media at substantially said recording frequency, to substantially  
17      eliminate net magnetization in the magnetic media.

18

19       35.    The data storage device of claim 34, wherein the controller is  
20      further configured to:

21           (i)     write on a portion of the magnetic media with the transducer  
22      head at a selected recording frequency;  
23           (ii)    read from said portion of the magnetic media, generating a  
24      readback signal;  
25           (iii)    if the amplitude of the readback signal is not essentially at a  
26      predetermined level, then the controller repeats steps (i) through (iii) for a  
27      different selected recording frequency, until the amplitude of the readback signal  
28      is essentially at the predetermined level; and  
29           (iv)    write on the magnetic media with the transducer head at the  
30      last selected recording frequency, to substantially eliminate net magnetization in  
31      the magnetic media.

1

2       36. The data storage device of claim 34, wherein the controller is  
3 configured to:

4                 writes on the magnetic media with the transducer head at one or  
5 more different recording frequencies, and compare the amplitude of a readback  
6 signal at each recording frequency to a noise level to selecting a recording  
7 frequency at which the amplitude of the readback signal is essentially the same  
8 as the noise level; and

9                 write on the magnetic media with the transducer at substantially  
10 said selected recording frequency, to essentially eliminate net magnetization in  
11 the magnetic media.

12

13       37. The data storage device of claim 34, wherein the controller is  
14 configured to:

15                 (i)    select a recording frequency;  
16                 (ii)    write on a portion of the magnetic media with the transducer  
17 head at the selected recording frequency;  
18                 (iii)   read from said portion of the magnetic media with said  
19 transducer head, generating a readback signal;  
20                 (iv)    compare the amplitude of the readback signal to noise level,  
21 such that if the amplitude of the readback signal is greater than a noise level,  
22 then the controller selects another recording frequency, and repeats steps (ii)  
23 through (iv) until the amplitude of the readback signal is essentially at said noise  
24 level; and

25                 write on the magnetic media at the last selected recording  
26 frequency.

27

28       38. The data storage device of claim 37, wherein the controller initially  
29 selects a low recording frequency.

30

1           39. The data storage device of claim 38, wherein the controller selects  
2 said another recording frequency higher than a preceding recording frequency.  
3

4           40. The data storage device of claim 37, wherein the controller selects  
5 said another recording frequency lower than a preceding recording frequency.  
6

7           41. The data storage device of claim 34, wherein:  
8                 the storage media comprises a magnetic data disk for writing data  
9 thereon in concentric tracks in a disk drive;  
10                 the controller comprises a disk drive controller configured to:  
11                         write on a test track on the magnetic disk;  
12                         reading from the test track on the magnetic disk;  
13                         use said determined recording frequency to write on multiple  
14                 tracks on the magnetic disk at said last determined recording frequency, to  
15                 substantially eliminate net magnetization in said multiple tracks.  
16

17           42. A method of using manufacturing a disk drive, comprising the steps  
18 of:  
19                 (a) providing a magnetic data disk without net magnetization;  
20                 (b) providing a transducer head for recording data on said magnetic  
21 data disk;  
22                 (c) providing a disk drive controller for controlling the transducer head  
23 in writing data on the magnetic data disk; and  
24                 (d) assembling the magnetic data disk, the transducer head and the  
25 controller for data record/playback operations.  
26

27           43. The method of claim 42, wherein the magnetic disk is result of a  
28 sputtering process essentially without any net magnetization.  
29

30           44. A method of demagnetizing magnetic data disk for recording data in  
31 concentric tracks in a data storage device, comprising the steps of:

1           (a) selecting multiple consecutive tracks; and  
2           (b) recording on said multiple tracks with a transducer head by  
3       alternating the polarity of the write current in the transducer head from one track  
4       to the next, to substantially eliminate net magnetization in said multiple tracks.

5

6       45. The method of claim 44, wherein step (b) further comprises the  
7       steps of:

- 8           (i) stepping the head radially to a first track in said multiple tracks;  
9           (ii) applying a write current to the transducer head and recording on  
10      the first track;  
11           (iii) stepping the head radially over the next track;  
12           (iv) reversing the polarity of the write current in the transducer head  
13      and recording on that track; and  
14           (v) repeating steps (iii)-(iv) to the last track of said multiple tracks.

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16       46. The method of claim 45, wherein in step (b) alternating polarity of  
17      the write current includes the steps alternating polarity of DC write current in the  
18      transducer from one track to the next.